

Electroweak Physics with an Electron Ion Collider

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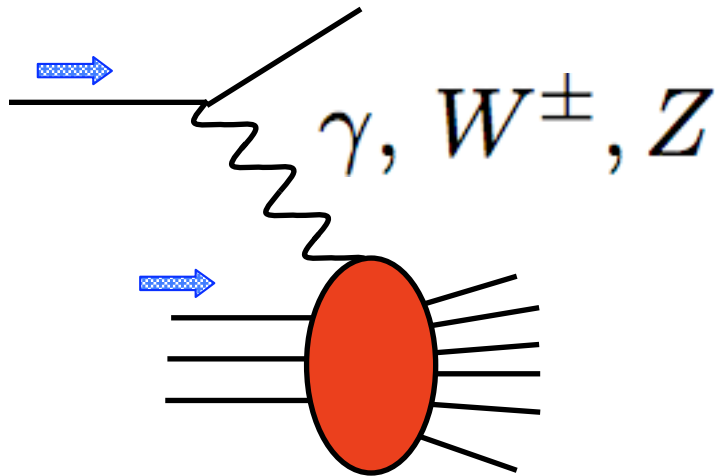
The EIC will provide groundbreaking insights into the structure of nucleon and nuclei, and into QCD dynamics.

It has recently been discussed that the EIC might also make significant contributions to our understanding of the electroweak interactions.

No detailed studies available yet.

This LDRD: Explore the opportunities for doing electroweak physics at an EIC

Topic I: Nucleon (& nuclear?) structure through EW DIS



Wray, Derman, Ahmed Ross, Lampe,
Weber Stratmann WV
Ji, Anselmino Gambino Kalinowski, ...

$$g_1^{(W^-)} = \Delta u + \Delta \bar{d} + \Delta \bar{s}$$

$$g_5^{(W^-)} = \Delta u - \Delta \bar{d} - \Delta \bar{s}$$

$$g_1^{(W^+)} = \Delta d + \Delta \bar{u} + \Delta s$$

$$g_5^{(W^+)} = \Delta d - \Delta \bar{u} + \Delta s$$

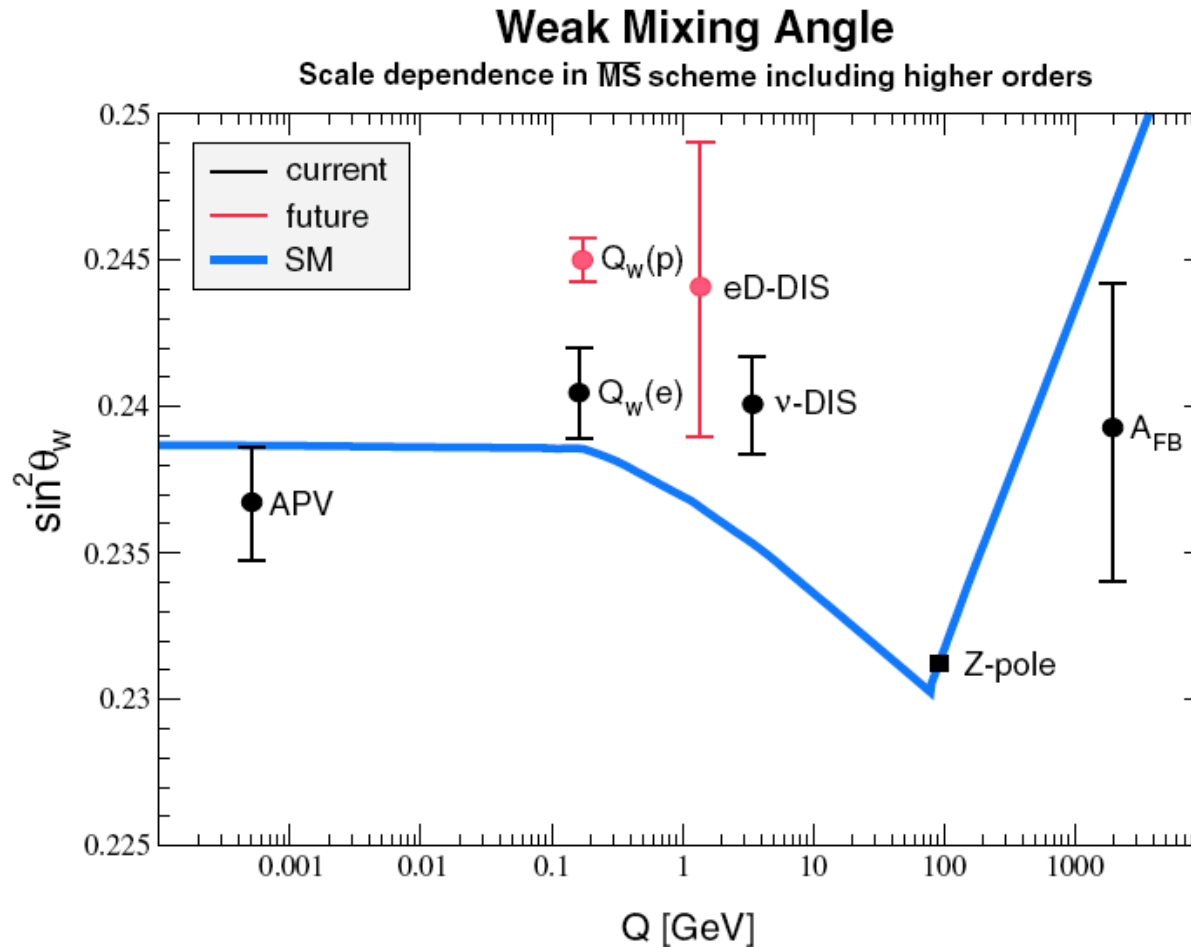
- “doable” with sufficient energy/lum. Some studies done.

De Roeck, Deshpande

- NLO corr. known

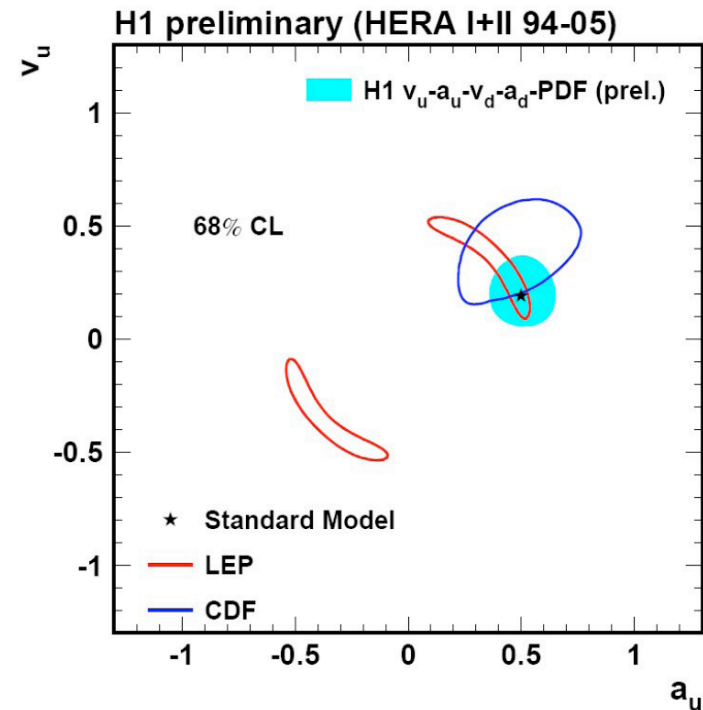
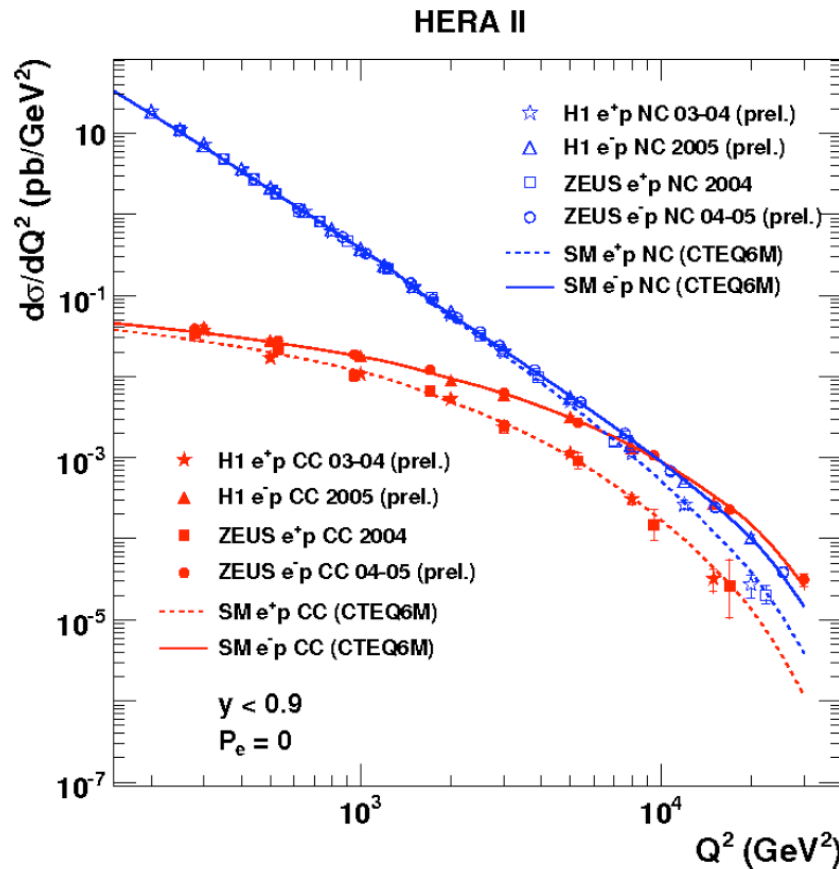
$$\int_0^1 dx \left[g_5^{(W^+)} p - g_5^{(W^+)} n \right] = - \left(1 - \frac{2\alpha_s(Q^2)}{3\pi} \right) g_A$$

Topic II: measurement of EW quantities at EIC ?



- initial study for EIC: Rolf Ent '04
- QCD and EW corrections needed

a lot of experience from HERA (200/pb):



- identify optimal observables
- identify requirements for accelerator and detector

Topic III: access to beyond-SM physics ?

- comprehensive search for (PV) new neutral current interactions ?
- $e^- + p \rightarrow \tau^- + X$ lepton flavor violation ?
- special demands on detector
- requires careful assessment of existing (and expected!) limits from other experiments.
(LHC, $\tau \rightarrow e\gamma$...)

Scope:

Plan is to hire a theory postdoc who will perform the relevant calculations and studies

Will work closely with EIC experimentalists, in order to determine requirements for machine and detectors

Plan to support (exp.) students (about 9 months total)

Sufficient funds for short- and medium-term visitors, including proposers

Plan for one workshop

Total budget about \$360k